eInstrument Node User's Manual

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The eInstrument Node User's Manual was prepared by the technical staff of Innovative Integration on April 3, 2015.
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#XXXXXX
Rev 1.0 Initial release.
Rev 1.1 Standalone use described. Added Rev D layout.
Rev 1.2 Updated for Rev E PCBA.

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Introduction

Real Time Solutions!

Thank you for choosing Innovative Integration, we appreciate your business! Since 1988, Innovative Integration has grown to become one of the world's leading suppliers of DSP and data acquisition solutions. Innovative offers a product portfolio unrivaled in its depth and its range of performance and I/O capabilities .

Whether you are seeking a simple DSP development platform or a complex, multiprocessor, multichannel data acquisition system, Innovative Integration has the solution. To enhance your productivity, our hardware products are supported by comprehensive software libraries and device drivers providing optimal performance and maximum portability.

Innovative Integration's products employ the latest digital signal processor technology thereby providing you the competitive edge so critical in today's global markets. Using our powerful data acquisition and DSP products allows you to incorporate leading-edge technology into your system without the risk normally associated with advanced product development. Your efforts are channeled into the area you know best ... your application.

What is eInstrument Node?

eInstruments are Innovative's family of embedded instrumentation products. These products are used to solve a variety of IO, signal processing and embedded computing applications that require a smart device for local data acquisition and processing. eInstruments enable distributed processing using modular IO with FPGAs and processors that collect and process data, allowing complex systems to be engineered and managed in a flexible, extensible way.

Innovative Integration Technical Support

Innovative provides technical support via telephone or internet.

Hotline (805) 578-4260 8:00AM-5:00 PM PST.

Alternately, you may e-mail your technical questions at any time to:

techsprt@innovative-dsp.com.

Innovative Integration Web Site

Additional information on Innovative Integration hardware and software are available via the Innovative Integration website at

www.innovative-dsp.com

Typographic Conventions

This manual uses the typefaces described below to indicate special text.

Typeface	Meaning
`Source Listing`	Text in this style represents text as it appears onscreen or in code. It also represents anything you must type.
Boldface	Text in this style is used to strongly emphasize certain words.
Emphasis	Text in this style is used to emphasize certain words, such as new terms.
Cpp Variable	Text in this style represents C++ variables
Cpp Symbol	Text in this style represents C++ identifiers, such as class, function, or type names.
KEYCAPS	Text in this style indicates a key on your keyboard. For example, “Press **ESC** to exit a menu”.
Menu Command	Text in this style represents menu commands. For example “Click View | Tools | Customize”

Installation

This chapter describes the hardware installation procedure for the host computer and the XMC module into the eInstrument Node.

For the software installation for the particular XMC module you are using, consult the documentation on that module.

Host Hardware Requirements

The host computer must have either a PCI Express cable connector, an open PCI Express or ExpressCard slot for installation. At the time of this manual, most computers require a PCI Express cable adapter card to communicate with the eInstrument Node. The PCI Express must be PCI Express 1.1 compatible, with 2.5 Gbps signaling.

If you intend to use an Innovative X3 or X5 family module, the host computer is recommended to be either Windows Vista or Linux. Innovative software makes extensive use of the Intel IPP software, so an Intel processor is recommended. Minimum recommended memory is 1 GB.

Adapter Card Installation

The PCI Express cable adapter card installs in either a PCI Express slot in a desktop system or using an ExpressCard slot in a note book computer.

Caution! These cards are sensitive to electrostatic discharge. Ground yourself to the computer during installation.

1. Turn power off and unplug the PC or notebook.
2. Insert the adapter card in the PCI Express slot or ExpressCard slot.
3. Secure the adapter bracket screw if chassis has provision for a screw.

XMC Installation

You will need a small flat head and a Philips head screwdriver for this installation.

1. Be sure the eInstrument Node is unplugged from power and its PCI Express cable is not attached.
2. Remove the three screws on the bottom of the enclosure.

3. Remove the two rear bracket screws.

4. Slide the entire inner assembly and top cover to the rear about 1 inch (2 cm).

5. Detach the front panel switch connector by reaching in the front of the unit and pulling up on the switch connector.

6. Slide the entire inner assembly out of the enclosure.

7. Install XMC cooling bars if required. For X3 modules, only the bar in the center of the card is used. For X5 modules, the two side cooling bars are used.

8. Install the XMC module. Carefully insert the module connectors and push the module in until the connectors are fully inserted and the front bracket is flat on the card.

9. Install the screws holding the module to the cooling bars.

10. Install the screws for the module standoffs.

11. Install screws holding the XMC bracket to the card. These install from the bottom of the assembly.

12. Configure the jumper for the fan to be always on or controlled by the XMC module.

13. Slide the top cover into the enclosure, stopping about about 1 inch (2 cm) from completely coving the enclosure. The cover perforations should be toward the front of the unit.

14. Slide the inner assembly with the XMC module into the enclosure to about 1 in (2 cm) from the end. The card slides in the enclosure using the extrusion slot just BELOW the centerline large extrusion that is threaded.

15. Plug the front panel switch into connector JP3.

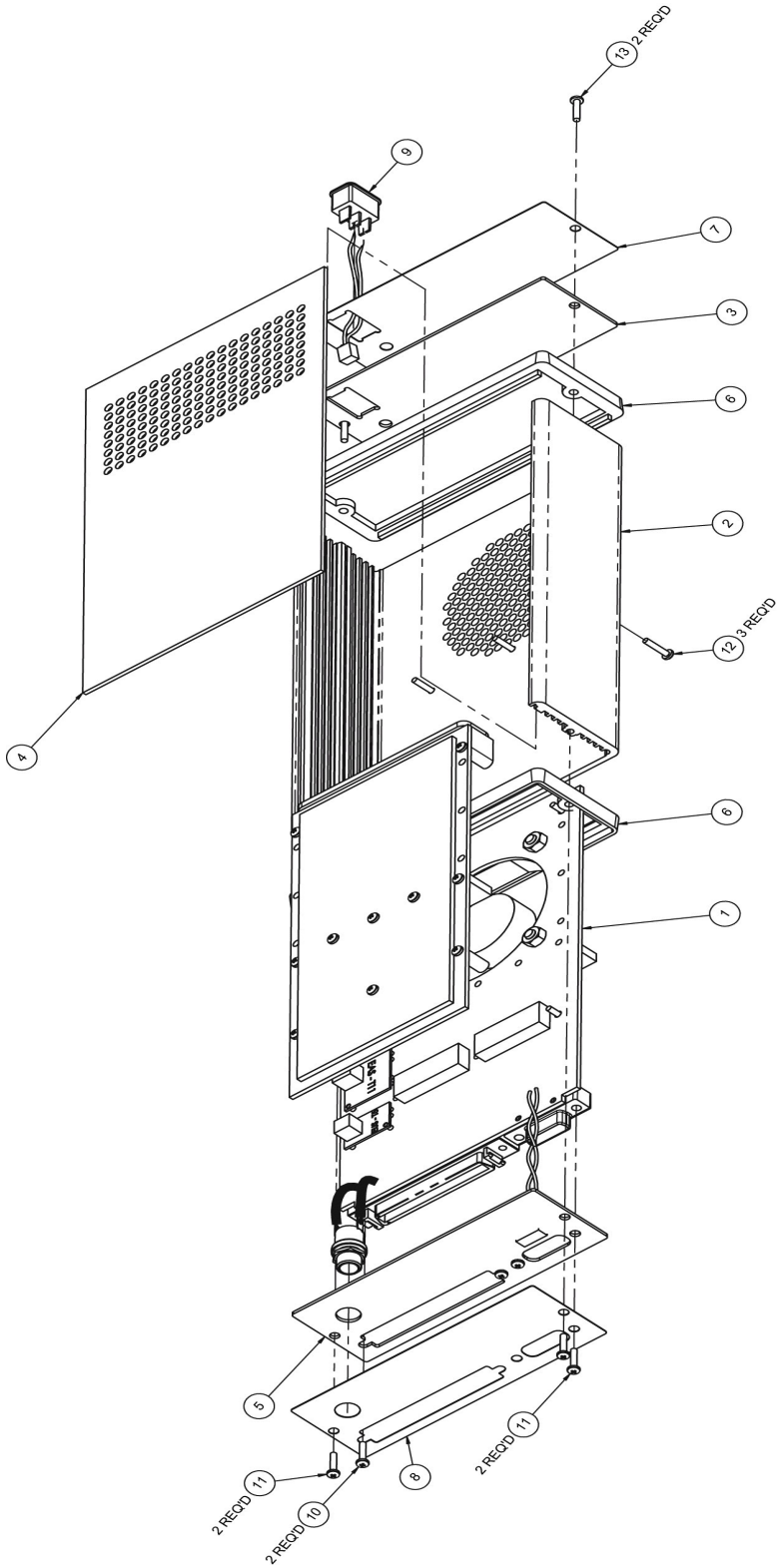
16. Slide the assembly and top into the enclosure until the XMC front bracket touches the front panel.

17. Install screws through the chassis bottom into the cooling bar. DO NOT FULLY TIGHTEN THE SCREWS at this point.

18. Check the fit and then install the rear panel screws. They should be snug, do not overtighten.

19. Now tighten up the bottom screws for the cooling bar.

20. The assembly is complete at this point and ready for connection to the system.


13 2 REQ'D
9
7
3
6
2
12 3 REQ'D
4
6
1
5
11 2 REQ'D
8
11 2 REQ'D
10 2 REQ'D

Bill of Materials for Enclosure

ITEM NO.	QTY PER	PART NO.	REF DES SEE DWG FOR 80185	Description
1	1	80182-0	1	XMCe CARRIER for Cabled PCI Express
2	1	63119	2	Chassis Extrusion, Modified from Lansing Micropac E
3	1	63122	3	Rear end plate for cabled PCIe enclosure
4	1	63120	4	Cover Plate, Modified from Lansing Micropac E
5	1	63121	5	Front end plate for cabled PCIe enclosure
6	2	63125	6	Bezel for Lansing Micropak E, plastic
7	1	64069	7	OVERLAY, MYLAR, FOR REAR PANEL eINSTRUMENT NODE ENCLOSURE (80185)
8	1	64068	8	OVERLAY, MYLAR, FOR FRONT PANEL eINSTRUMENT NODE ENCLOSURE (80185)
9	1	67063	9	ASSEMBLY CABLE, FRONT PANEL BUTTON AND CABLE FOR CABLED PCIE XMC ENCLOSURE (80185)
10	2		10	JACKSCREW FOR MDR68
11	2		11	JACKSCREW 4/40 MALE/FEMALE ½ IN
12	3	63142	12	SCREW M2 X 6MM S.S.PAN HEAD
13	4	63141	13	SCREW, 4/40 X 3/8IN PAN HEAD BLACK OXIDE

Connection to the Host System

The eInstrument Node connects to the host system using a PCI Express cable. Connect the cable to P1 on the rear panel, labeled PCI Express. The other end of the cable connects to the host computer.

Attach Power Supply

The eInstrument Node uses 12V dc to power the Node electronics and XMC module. With the power switch in the down position, attach the power supply to the rear panel connector. The unit will not power on until the PCI Express cable is attached and the power switch is in the up position.

Attach IO Cables

Now install any application cables. Connections to the XMC module SHOULD be made before power on. These include front panel cables to the XMC module and the rear panel Digital IO connector.

Ready to Use

The eInstrument Node should now be ready for use. It is always a good idea to double-check all cables and power supply connections before power on to prevent damage.

The XMC module may require software installation to operate. After performing the software installation for the XMC, your eInstrument Node will enumerate in the host computer and is ready to use.

eInstrument Node Hardware

Introduction

The eInstrument Node allows one PCI Express XMC module, VITA 42.3 compatible, to be used in a small enclosure that communicates with a host computer using cabled PCI Express. This allows the IO module to be located outside the host computer up to 5 meters away, yet still be part of the host computer from the software perspective. The high bandwidth PCI Express link over the cable is completely transparent to the software. No software drivers or changes to existing software are required to use the eInstrument Node.

Figure 1. eInstrument Node with XMC installed, cable and power supply

Integrated power supplies provide clean local power to the XMC module in the eInstrument Node. Since the Node is isolated from the host computer, a much more controlled electrical environment can result in better measurement quality for the XMC module.

The eInstrument Node provides conduction and convection cooling for the XMC module. XMC modules with conduction cooling per VITA 20 standard can use the eInstrument Node conductive cooling features to pull heat from the module and distribute it to the enclosure. A fan may also be used to cool the XMC module and is located directly under the XMC.

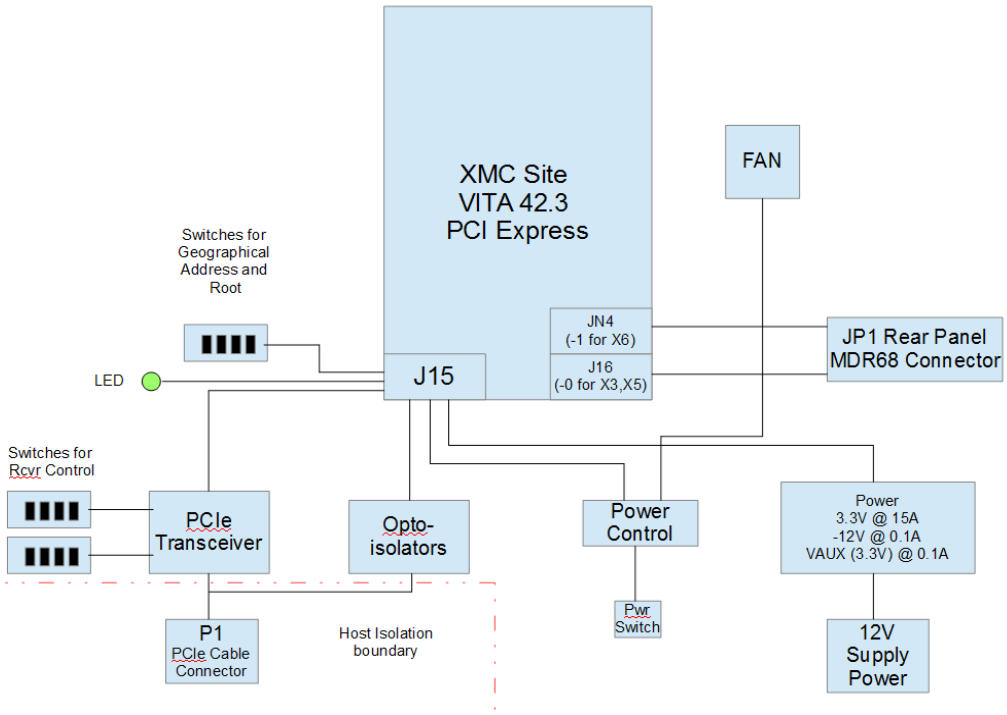
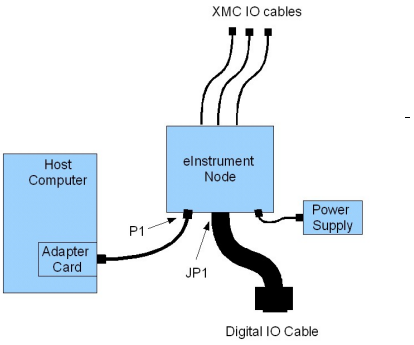


Figure 2. eInstrument Node Block Diagram

Standard Connections to the eInstrument Node

The eInstrument node requires a connection to the host computer and an external power supply. In addition, some XMC modules such as Innovative X3 and X5 families have digital IO connections to the rear panel. The front panel provides access to the XMC IO connections.



XMC Module Site

The eInstrument Node has a single XMC module site. This module site hosts one PCI Express XMC module compliant to VITA 42.3 specification. Modules must comply to this interface standard and mechanical description.

XMC Mechanicals

The XMC must conform to VITA 42, with an IEEE 1386 form-factor for a single width mezzanine card. Mechanicals for the card are shown here.

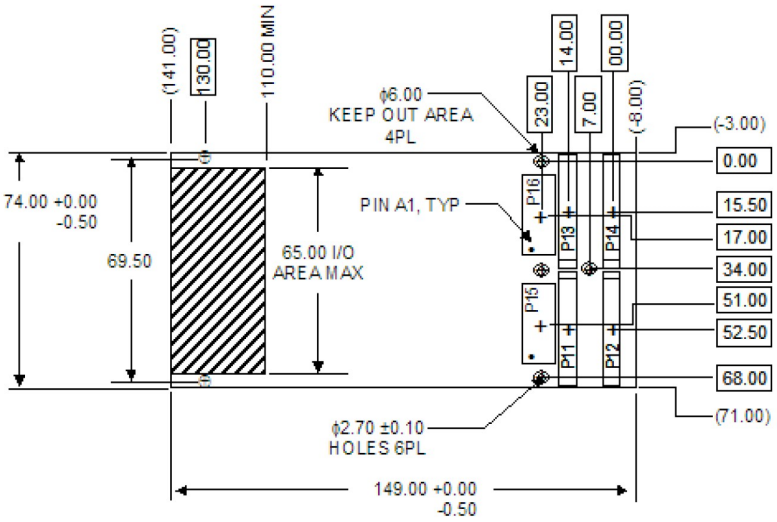


Figure 3. XMC Module Dimensions

Spacing from the XMC module to the carrier PCB is 10mm. The shaded zone shown in the figure has no components on the carrier card.

Power to the XMC

The eInstrument Node has power supplies to support the XMC module. Input power is nominally 12V and limited to 5A. Supplies in the eInstrument Node provide the other voltages required by the XMC. The rated value of each supply is shown, however total current is limited to 5A.

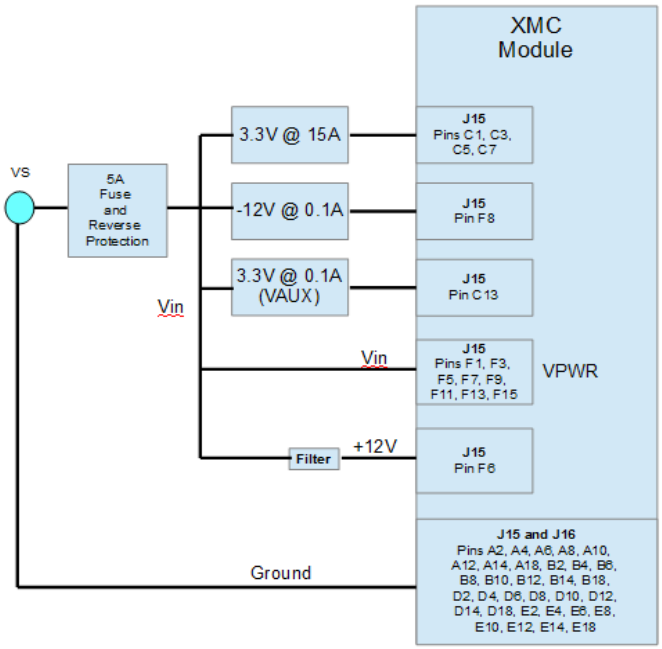


Figure 4. eInstrument Node Power Diagram

Note that the Vin supply is directly connected to the VPWR pins of the XMC. If the XMC uses these power supply connections, range and noise limitations of the module should be considered. Consult the data sheet of each module to verify its range of operation and noise requirements.

Typical Output Voltage	Min Output Voltage	Max Output Voltage	Output Voltage Noise (Typical)	Output Minimum Current	Output Maximum Current	XMC Connector/Pins
3.3V	3.2V	3.4V	30 mVp-p	0	15A	J15 pins C1, C3, C5, C7
-12V	-11.6	-12.4	250 mVp-p	0	0.10A	J15 pin F8
Vin	Dependent on VS	Dependent on VS	Dependent on VS	Dependent on VS	5A	J15 Pins F1, F3, F5, F7, F9, F11, F13, F15

+12V (Filtered Vin)	Dependent on VS	Dependent on VS	Dependent on VS	Dependent on VS	5A	J15 Pin F6
Standby 3.3V (VAUX)	3.2V	3.4V	10 mVp-p	-	100mA	J15 pin C13

Table 1. eInstrument XMC Power

Special Purpose Pins

In addition to the required signals, the carrier uses a few reserved signals to provide additional controls between the XMC and carrier card.

Signal	Direction	XMC Connector/Pin	Function
LED Control	From XMC	J15/F19	Front panel LED control. '0' = on.
Fan Control	From XMC	J15/C19	Fan control. '1' = on. Jumper JP5 must be installed (shorted).
VPWR	To XMC	J15/ F1,F3,F5,F7,F9,F11,F13,F15	+12V from power supply. Current limited to 5A.
GA0	To XMC	J15/F10	Geographical address 0.
GA1	To XMC	J15/C12	Geographical address 1.
GA2	To XMC	J15/C14	Geographical address 2.
ROOT	To XMC	J15/E19	ROOT is used by XMC modules that can be configured as the PCI Express root port.

Table 2. XMC Special Purpose Pins

Controls to the XMC

The geographic address can be set to the XMC as well as the PCI Express ROOT control using switch SW3.

The geographic address is used to set a specific address for each eInstrument Node so that software and hardware can configure itself according to its location. Implementation of these features is specific to each XMC module, so consult the manual for the XMC you are using.

The ROOT control tells the XMC module that it is the PCI Express root device. This control is normally off, indicating that the XMC is the endpoint device.

Switch	Function	Settings	Notes
3:1	Geographic Address[2:0]	On = '0' on-on-on = address "000" (default)	Geographic address features are module specific.
4	PCIe ROOT	On = ROOT Off = Endpoint (default)	Endpoint device means that the host computer controls the PCI Express bus (default). ROOT means the XMC controls the PCI Express bus.

Table 3. XMC Controls using SW3

PCI Express Interface

The PCI Express interface is a single (x1) lane operating at 2.5 Gbps that is connected to the host computer through a cable. The interface is full duplex (sends and receives simultaneously). The interface supports burst rates of 250 MB/s and continuous data rates of about 200 MB/s between the module and the host.

Limits on data transfer rates are determined primarily by the XMC and host computer capabilities. The only impact that the eInstrument node has on performance is that the cable introduces some additional latency in the link. This latency can affect overall rate because PCI Express credit management, as well as the whatever mechanism the XMC uses for data transfer, are slowed by the cable length. This is not usually an even measurable effect.

The PCI Express interface is completely compatible with any PCI Express system and complies with PCI Express Gen 1 1.1 specifications. The cable is defined in the PCI Express Cable Interface 1.0 specification. The approved cable is is provided in this manual.

PCI Express Cables

The PCI Express cable is available in several lengths. The eInstrument Node settings at the factory are for the 1m cable.

Innovative Part Number	Description	Manufacturer	Manufacturer Part Number
67057	PCI Express Cable, x1 lane, 5 meter	Molex	7457600005
67058	PCI Express Cable, x1 lane, 3 meter	Molex	7457600003
67059	PCI Express Cable, x1 lane, 1 meter	Molex	7457600001

Table 4. Approved PCI Express cable list for eInstrument Node

Electrical Isolation and Hot Plug

The eInstrument Node is electrically isolated from the host computer. The isolation barrier in the eInstrument Node separates the local power to the XMC from the host computer power. Interface electronics to the eInstrument Node that communicate with the host computer are powered by the host computer over the PCI Express cable.

As defined in the PCI Express Cable Specification, the PCI Express cable supports hot-plug operation. Since the eInstrument Node is electrically isolated, it is safe to hot plug the unit. It is also safe to turn the unit on or off while the host computer is connected.

Tuning for PCI Express Cable Lengths and Signal Quality

The eInstrument Node has tuning controls for the PCI Express cable interface that adjust the signal amplitude, de-emphasis, and equalization characteristics to improve reliability for longer cables. These controls are set at the factory for the 1 meter cable.

Switches SW1 and SW2 are used for the receive and transmit tuning. These are dip switches located on the card which must be set manually during the tuning procedure. The default settings are the recommended settings for most applications.

Switch	Tuning Control	Default (4:1)
SW1	Receive (cable to XMC)	0000 (off-off-off-off)
SW2	Transmit (XMC to cable)	0000 (off-off-off-off)

Switch	Function	Settings	Notes
2:1	Receive equalization	00 = no equalization 01 = 0 : 2.54 dB 10 = 2.5 : 4.5 dB 11 = 4.5 : 6.5 dB	SW1: Tunes the signal to the XMC from the cable SW2: Tunes the signals to the cable from the XMC Higher equalization is usually required for longer cables
3	Output swing	0 = 1x 1 = 1.2x	Higher output swing is usually required for longer cables
4	Output De-emphasis	0 = 0 dB 1 = -3.5 dB	Output De-emphasis may be required for short cables or for signals to the PCI Express host bus.

Figure 5. Settings for PCI Express Transceiver Switches

Note: Switches in the ON position are 0 in this table.

The recommended tuning procedure is to connect the adapter to the remote device and perform a test for data integrity. This could be a large data transfer or communications test to the remote device. The signal tuning should be changed until reliable

data transfers are achieved.

Innovative provides test programs to validate connection quality for its data acquisition cards that are included with each XMC module.

Standalone Operation

Beginning with Revision C, The eInstrument Node supports standalone operation, allowing XMC modules to operate without PCI Express interface. This is convenient for embedded applications where the node is simply used to host a module.

Prerequisites for Standalone Operation

Standalone operation is predicated on several conditions:

1. The module must be able to operate without PCI Express signals, including the 100 MHz reference clock provided by the bus.
2. The module must control its own reset. No bus reset is provided.
3. The module must be able to boot itself. (Innovative X3 series modules do NOT have this capability. X5 and X6 modules are able to boot and run standalone.)

Power Control in Standalone Mode

The power control to the eInstrument node may be controlled solely by the front panel power switch by install a jumper on JP7. This jumper overrides the PCI Express power control and should be removed if the PCI Express interface is used.

Jumper	Function	SettingJP7
JP7	Standalone power enable	Shorted (standalone mode) Open (PCI Express host mode, default)

Figure 6. Standalone Power Enable

If the eInstrument Node card is Rev B, contact technical support for details on standalone use.

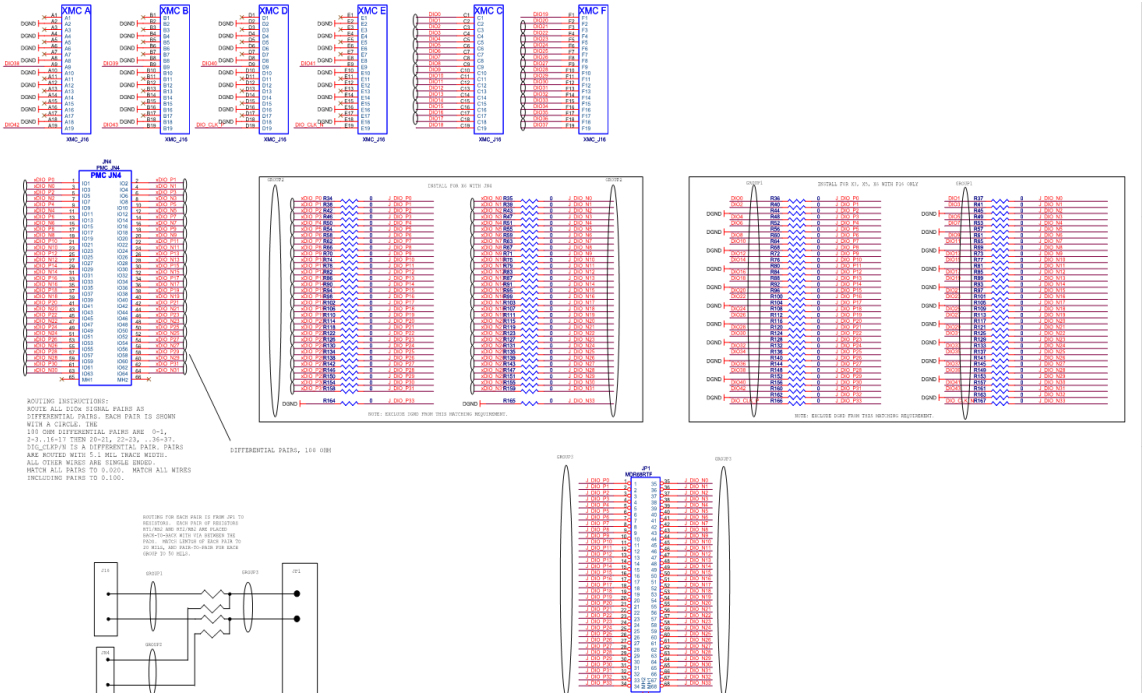
Notes for Standalone Use with Innovative XMC Modules

Innovative XMC module families require various modifications to work standalone.

Module Family	Standalone Operation Requirements
X3	The X3 modules are not able to boot and run standalone because the application logic image is loaded over PCI Express bus.
X5	X5 modules support standalone operation and boot from on-module FLASH memory. The application logic must be modified to run without PCI Express functions, including temperature monitoring. It is important to implement temperature monitoring function in standalone mode to prevent overheating. See X5 Framework Logic User Guide for details on the required logic modifications.
X6	X5 modules support standalone operation and boot from on-module FLASH memory. The application logic must be modified to run without PCI Express functions. Temperature monitoring is not affected. See X5 Framework Logic User Guide for details on the required logic modifications.

Digital IO Connector

The eInstrument Node Rev E provides DIO Signal access through the JP1 Connector. There are two versions of eInstrument Node. The -0 version supports DIO access for X3 and X5 Series boards. The -1 version supports DIO access for X6 Series boards.



eInstrument Node DIO Signal Mapping (X3, X5 Series J16 usage)

The -0 version eInstrument Node DIO signals use 0 ohm resistor jumpers to route the DIO signals from the P16 connector to JP1 Connector. J16 is the mating XMC connector on the XMC Module for the eInstrument Node P16 connector.

The DIO signal mapping below is required because of the differential DIO scheme used on the X6 Series modules. Beware that the XMC module DIO# will not match the eInstrument Node JP1 J_DIO_P# in all but one case (DIO0).

DIO Signal	P16 Connector	JP1 Connector	DIO Signal
DIO0	Pin C1	Pin 1	J_DIO_P0
DIO1	Pin C2	Pin 35	J_DIO_N0
DIO2	Pin C3	Pin 2	J_DIO_P1
DIO3	Pin C4	Pin 36	J_DIO_N1
DGND	NC	Pin 3	J_DIO_P2
DGND	NC	Pin 37	J_DIO_N2
DIO4	Pin C5	Pin 4	J_DIO_P3
DIO5	Pin C6	Pin 38	J_DIO_N3
DIO6	Pin C7	Pin 5	J_DIO_P4
DIO7	Pin C8	Pin 39	J_DIO_N4
DGND	NC	Pin 6	J_DIO_P5
DGND	NC	Pin 40	J_DIO_N5
DIO8	Pin C9	Pin 7	J_DIO_P6
DIO9	Pin C10	Pin 41	J_DIO_N6
DIO10	Pin C11	Pin 8	J_DIO_P7
DIO11	Pin C12	Pin 42	J_DIO_N7
DGND	NC	Pin 9	J_DIO_P8
DGND	NC	Pin 43	J_DIO_N8
DIO12	Pin C13	Pin 10	J_DIO_P9
DIO13	Pin C14	Pin 44	J_DIO_N9
DIO14	Pin C15	Pin 11	J_DIO_P10
DIO15	Pin C16	Pin 45	J_DIO_N10
DGND	NC	Pin 12	J_DIO_P11
DGND	NC	Pin 46	J_DIO_N11
DIO16	Pin C17	Pin 13	J_DIO_P12

DIO17	Pin C18	Pin 47	J_DIO_N12
DIO18	Pin C19	Pin 14	J_DIO_P13
DIO19	Pin F1	Pin 48	J_DIO_N13
DGND	NC	Pin 15	J_DIO_P14
DGND	NC	Pin 49	J_DIO_N14
DIO20	Pin F2	Pin 16	J_DIO_P15
DIO21	Pin F3	Pin 50	J_DIO_N15
DIO22	Pin F4	Pin 17	J_DIO_P16
DIO23	Pin F5	Pin 51	J_DIO_N16
DGND	NC	Pin 18	J_DIO_P17
DGND	NC	Pin 52	J_DIO_N17
DIO24	Pin F6	Pin 19	J_DIO_P18
DIO25	Pin F7	Pin 53	J_DIO_N18
DIO26	Pin F8	Pin 20	J_DIO_P19
DIO27	Pin F9	Pin 54	J_DIO_N19
DGND	NC	Pin 21	J_DIO_P20
DGND	NC	Pin 55	J_DIO_N20
DIO28	Pin F10	Pin 22	J_DIO_P21
DIO29	Pin F11	Pin 56	J_DIO_N21
DIO30	Pin F12	Pin 23	J_DIO_P22
DIO31	Pin F13	Pin 57	J_DIO_N22
DGND	NC	Pin 24	J_DIO_P23
DGND	NC	Pin 58	J_DIO_N23
DIO32	Pin F14	Pin 25	J_DIO_P24
DIO33	Pin F15	Pin 59	J_DIO_N24
DIO34	Pin F16	Pin 26	J_DIO_P25
DIO35	Pin F17	Pin 60	J_DIO_N25
DGND	NC	Pin 27	J_DIO_P26
DGND	NC	Pin 61	J_DIO_N26
DIO36	Pin F18	Pin 28	J_DIO_P27
DIO37	Pin F19	Pin 62	J_DIO_N27

DIO38	Pin A9	Pin 29	J_DIO_P28
DIO39	Pin B9	Pin 63	J_DIO_N28
DGND	NC	Pin 30	J_DIO_P29
DGND	NC	Pin 64	J_DIO_N29
DIO40	Pin D9	Pin 31	J_DIO_P30
DIO41	Pin E9	Pin 65	J_DIO_N30
DIO42	Pin A19	Pin 32	J_DIO_P31
DIO43	Pin B19	Pin 66	J_DIO_N31
DGND	NC	Pin 33	J_DIO_P32
DGND	NC	Pin 67	J_DIO_N32
DIO_CLK_P	Pin D19	Pin 34	J_DIO_P33
DIO_CLK_N	Pin E19	Pin 68	J_DIO_N33

Table 5. eInstrument Node -0 DIO Signal Mapping

eInstrument Node DIO Signal Mapping for -1 (X6 Series JN4 usage)

The -1 version eInstrument Node DIO signals use 0 ohm resistor jumpers to route the DIO signals from the JN4 connector to JP1 Connector.

DIO Signal	JN4 Connector	JP1 Connector	DIO Signal
xDIO_P0	Pin 1	Pin 1	J_DIO_P0
xDIO_N0	Pin 3	Pin 35	J_DIO_N0
xDIO_P1	Pin 2	Pin 2	J_DIO_P1
xDIO_N1	Pin 4	Pin 36	J_DIO_N1
xDIO_P2	Pin 5	Pin 3	J_DIO_P2
xDIO_N2	Pin 7	Pin 37	J_DIO_N2
xDIO_P3	Pin 6	Pin 4	J_DIO_P3
xDIO_N3	Pin 8	Pin 38	J_DIO_N3
xDIO_P4	Pin 9	Pin 5	J_DIO_P4
xDIO_N4	Pin 11	Pin 39	J_DIO_N4
xDIO_P5	Pin 10	Pin 6	J_DIO_P5
xDIO_N5	Pin 12	Pin 40	J_DIO_N5

xDIO_P6	Pin 13	Pin 7	J_DIO_P6
xDIO_N6	Pin 15	Pin 41	J_DIO_N6
xDIO_P7	Pin 14	Pin 8	J_DIO_P7
xDIO_N7	Pin 16	Pin 42	J_DIO_N7
xDIO_P8	Pin 17	Pin 9	J_DIO_P8
xDIO_N8	Pin 19	Pin 43	J_DIO_N8
xDIO_P9	Pin 18	Pin 10	J_DIO_P9
xDIO_N9	Pin 20	Pin 44	J_DIO_N9
xDIO_P10	Pin 21	Pin 11	J_DIO_P10
xDIO_N10	Pin 23	Pin 45	J_DIO_N10
xDIO_P11	Pin 22	Pin 12	J_DIO_P11
xDIO_N11	Pin 24	Pin 46	J_DIO_N11
xDIO_P12	Pin 25	Pin 13	J_DIO_P12
xDIO_N12	Pin 27	Pin 47	J_DIO_N12
xDIO_P13	Pin 26	Pin 14	J_DIO_P13
xDIO_N13	Pin 28	Pin 48	J_DIO_N13
xDIO_P14	Pin 29	Pin 15	J_DIO_P14
xDIO_N14	Pin 31	Pin 49	J_DIO_N14
xDIO_P15	Pin 30	Pin 16	J_DIO_P15
xDIO_N15	Pin 32	Pin 50	J_DIO_N15
xDIO_P16	Pin 33	Pin 17	J_DIO_P16
xDIO_N16	Pin 35	Pin 51	J_DIO_N16
xDIO_P17	Pin 34	Pin 18	J_DIO_P17
xDIO_N17	Pin 36	Pin 52	J_DIO_N17
xDIO_P18	Pin 37	Pin 19	J_DIO_P18
xDIO_N18	Pin 39	Pin 53	J_DIO_N18
xDIO_P19	Pin 38	Pin 20	J_DIO_P19
xDIO_N19	Pin 40	Pin 54	J_DIO_N19
xDIO_P20	Pin 41	Pin 21	J_DIO_P20
xDIO_N20	Pin 43	Pin 55	J_DIO_N20
xDIO_P21	Pin 42	Pin 22	J_DIO_P21

xDIO_N21	Pin 44	Pin 56	J_DIO_N21
xDIO_P22	Pin 45	Pin 23	J_DIO_P22
xDIO_N22	Pin 47	Pin 57	J_DIO_N22
xDIO_P23	Pin 46	Pin 24	J_DIO_P23
xDIO_N23	Pin 48	Pin 58	J_DIO_N23
xDIO_P24	Pin 49	Pin 25	J_DIO_P24
xDIO_N24	Pin 51	Pin 59	J_DIO_N24
xDIO_P25	Pin 50	Pin 26	J_DIO_P25
xDIO_N25	Pin 52	Pin 60	J_DIO_N25
xDIO_P26	Pin 53	Pin 27	J_DIO_P26
xDIO_N26	Pin 55	Pin 61	J_DIO_N26
xDIO_P27	Pin 54	Pin 28	J_DIO_P27
xDIO_N27	Pin 56	Pin 62	J_DIO_N27
xDIO_P28	Pin 57	Pin 29	J_DIO_P28
xDIO_N28	Pin 59	Pin 63	J_DIO_N28
xDIO_P29	Pin 58	Pin 30	J_DIO_P29
xDIO_N29	Pin 60	Pin 64	J_DIO_N29
xDIO_P30	Pin 61	Pin 31	J_DIO_P30
xDIO_N30	Pin 63	Pin 65	J_DIO_N30
xDIO_P31	Pin 62	Pin 32	J_DIO_P31
xDIO_N31	Pin 64	Pin 66	J_DIO_N31
NA	NC	Pin 33	J_DIO_P32
NA	NC	Pin 67	J_DIO_N32
DGND	NC	Pin 34	J_DIO_P33
DGND	NC	Pin 68	J_DIO_N33

Table 6. eIntrument Node DIO Signal Mapping

Consult the documentation for each module for J16 usage or JN4 usage on that module.

Cooling the XMC

The XMC can be cooled using both conduction cooling and with a fan in the enclosure. When these features are used, XMC modules up to 30W can be used.

Conduction Cooling

The conduction cooling for the module uses thermal conduction to the enclosure to spread the heat as much as possible. The enclosure is made from extruded aluminum and provides a good heat sink for the module so the heat is conducted from the module out to the enclosure.

The module mounts to the carrier card and attaches to exposed areas for heat conduction. This conductive cooling area is designed to be used with modules that have ANSI/VITA 20 conduction cooling features. The eInstrument Node has implemented these features by providing the a subset of the VITA 20 pattern on the carrier card and aluminum bars that connect the module to the carrier and module.

To use the conduction cooling bars, the carrier card must be removed from the enclosure. Then attach the bars to the card using the screws through the bottom of the carrier. DO NOT OVER-TIGHTEN THE SCREWS. The screws should just be snug. There are three bars that can be used. Innovative X3 modules use a single bar across the middle of the card; X5 cards use two bars along each edge of the module.

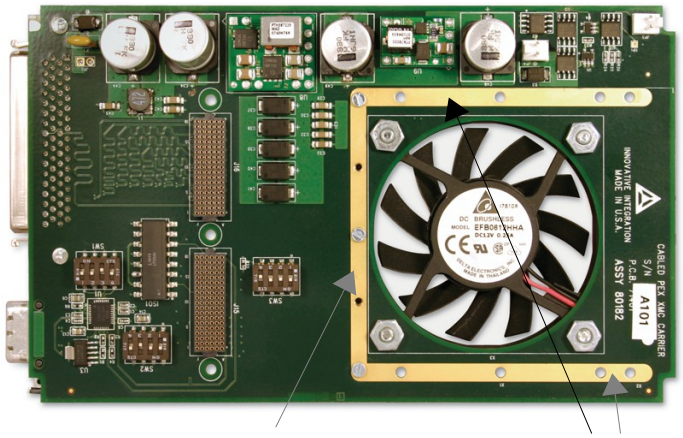


Figure 7. eInstrument Node carrier card conductive cooling area

Using the Fan

The carrier card also has a fan that blows directly on the XMC. In the enclosure, this fan provides about 2 CFM of cooling air. Air is drawn in the bottom of the enclosure and exits the top. It is important not to block these openings if the fan is used. The enclosure should be a minimum of ¼ inch above the tabletop for sufficient air flow.

The fan is either always on when power is on, always off, or can be controlled from the XMC through pin C19 on connector J15.

Fan Mode	JP3	R33
Always on (factory default)	open	open
Always off	open	short
XMC controlled	short	open

Table 7. Setting Fan Mode

Power Supply

The eInstrument Node uses a single +12Vdc power supply. Maximum supply current is 5A.

Innovative Part Number	Description	Manufacturer	Manufacturer Part Number
80191-0	Power supply, AC to DC, 110/220VAC, 12V @ 5A output, notebook style	CUI	ETS120500UTC-P5P-SZ

This is a universal power supply compatible with worldwide safety standards and is UL/CE/RoHS compliant. Power cords for USA, EU (P/N 65094) and UK (P/N 65095) styles are available.

Environmental Limits

Condition	Limits
Operating Temperature	0 to 55 C ambient (Recommended not to exceed 70C as measured by the on-card temp sensor)
Humidity	5 to 95 %, non condensing
Storage Temperature	-30 to 85 C
Forced Air Cooling	Forced air cooling required with a minimum of 5 CFM for 27C ambient.
Vibration, operating	ETS 300 019- 1.3 [R3], class 3.3 (Power cable screw attached.)
Vibration, storage	ETS 300 019- 1.1 [R1], class 1.2
Vibration, transportation	ETS 300 019- 1.2 [R2], class 2.3 except for free-fall: class 2.2

Table 8. eInstrument Node Environmental Limits

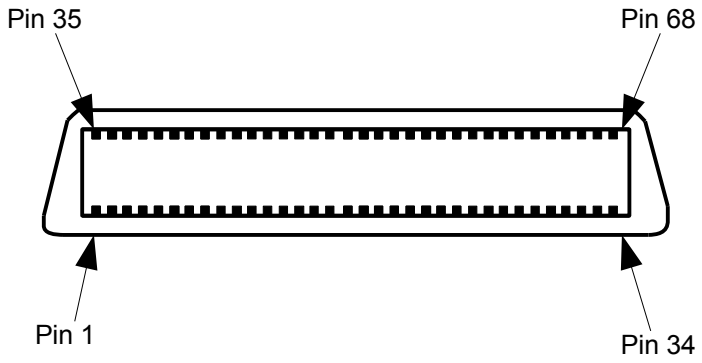
Connectors

Digital IO Connector JP1

JP1connector is the rear panel connector for the connection to J16 on the XMC module.

Connector Type:	MDR
Number of Connections:	68
Connector Part Number	3M part number 10268-55H3VC
Mating Connector:	3M part number 10168-6000EC (IDC) Digikey (www.digikey.com) P/N MPB68A-ND
Cable	Innovative part number 65057 MDR68 male to-male, 36 inches (0.91meters)

This is the MDR68 as viewed from the rear panel.



eInstrument Node JP1 Rear Panel Connector Pin Assignments

DIO0	1	I/O	I/O	35	DIO1
DIO2	2	I/O	I/O	36	DIO3
GND	3	P	P	37	GND
DIO4	4	I/O	I/O	38	DIO5
DIO6	5	I/O	I/O	39	DIO7
GND	6	P	P	40	GND
DIO8	7	I/O	I/O	41	DIO9
DIO10	8	I/O	I/O	42	DIO11
GND	9	P	P	43	GND
DIO12	10	I/O	I/O	44	DIO13
DIO14	11	I/O	I/O	45	DIO15
GND	12	P	P	46	GND
DIO16	13	I/O	I/O	47	DIO17
DIO18	14	I/O	I/O	48	DIO19
GND	15	P	P	49	GND
DIO20	16	I/O	I/O	50	DIO21
DIO22	17	I/O	I/O	51	DIO23
GND	18	P	P	52	GND
DIO24	19	I/O	I/O	53	DIO25
DIO26	20	I/O	I/O	54	DIO27
GND	21	P	P	55	GND
DIO28	22	I/O	I/O	56	DIO29
DIO30	23	I/O	I/O	57	DIO31
GND	24	P	P	58	GND
DIO32	25	I/O	I/O	59	DIO33
DIO34	26	I/O	I/O	60	DIO35
GND	27	P	P	61	GND
DIO36	28	I/O	I/O	62	DIO37
DIO38	29	I/O	I/O	63	DIO39
GND	30	P	P	64	GND
DIO40	31	I/O	I/O	65	DIO41
DIO42	32	I/O	I/O	66	DIO43
GND	33	P	P	67	GND
DIO CLK P	34	I/O	I/O	68	DIO CLK N

Note : - = No Connect, P = Power, I= Input, O = Output, I/O = Bidirectional. All are relative to X3 module.

XMC J15 Connector

J15 is the XMC PCI Express connector to the host.

Connector Types:	XMC pin header, 0.05 in pin spacing, vertical mount
Number of Connections:	114, arranged as 6 rows of 19 pins each
Connector Part Number	Samtec ASP-105884-01
Mating Connector:	Samtec ASP-105885-01

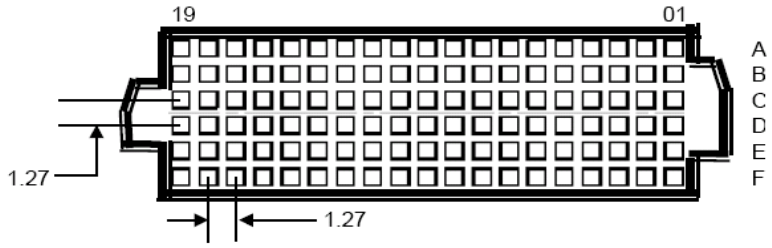


Figure 8. J15 XMC Connector Orientation

	Column					
Row	A	B	C	D	E	F
1	PET0p0	PET0n0	3.3V			VPWR
2	GND	GND		GND	GND	MRSTI#
3			3.3V			VPWR
4	GND	GND		GND	GND	MRSTO#
5			3.3V			VPWR
6	GND	GND		GND	GND	+12V
7			3.3V			VPWR
8	GND	GND		GND	GND	-12V
9						GA0
10	GND	GND		GND	GND	VPWR
11	PER0p0	PER0n0	MBIST#			MPRESENT#
12	GND	GND	GA1	GND	GND	VPWR
13			3.3VAUX			MSDA
14	GND	GND	GA2	GND	GND	VPWR
15						MSCL
16	GND	GND	MVMRO	GND	GND	
17						
18	GND	GND		GND	GND	
19	PEX REFCLK+	PEX REFCLK-	FAN CONTROL	WAKE#	ROOT#	LED

Table 9. XMC Connector J15 Pinout

Note: Special function pins are shown in yellow. These are reserved pins on VITA 42.3 specification.

Table 10. J15 Signal Descriptions

Signal	Description	P15 Pin
PET0p0/PET0n0	PCI Express Tx +/-	A1/B1
PER0p0/PER0n0	PCI Express Rx +/-	A11/B11
PEX REFCLK+/-	PCI Express reference clock, 100 MHz +/-	A19/B19
MRSTI#	Master Reset Input, active low	F2
MRSTO#	Master Reset Output, active low	F4
GA0	Geographic Address 0	F9
GA1	Geographic Address 1	C12
GA2	Geographic Address 2	C14
MBIST#	Built-in Self Test, active low	C11
MPRESENT#	Present, active low	F11
MSDA	PCI Express Serial ROM data	F13
MSCL	PCI Express Serial ROM clock	F15
MVMRO	PCI Express Serial ROM write enable	C16
WAKE#	Wake indicator to upstream device, active low	D19
ROOT#	Root device, active low	E19

XMC J16 Connector

J16 is the XMC secondary connector to the host and is used for digital IO, data link and triggering functions.

Connector Types:	XMC pin header, 0.05 in pin spacing, vertical mount
Number of Connections:	114, arranged as 6 rows of 19 pins each
Connector Part Number	Samtec ASP-105884-01
Mating Connector:	Samtec ASP-105885-01

Figure 9. J16 XMC Connector Orientation

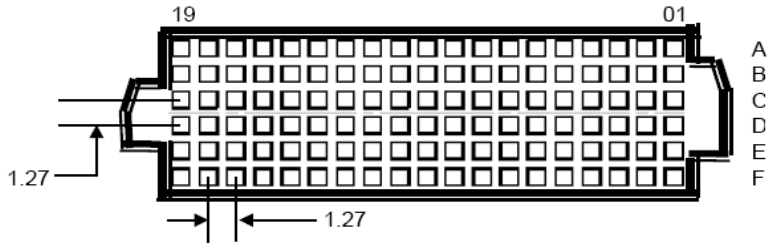


Table 11. XMC Secondary Connector J16 Pinout

	Column					
Row	A	B	C	D	E	F
1	-	-	DIO0	-	-	DIO19
2	DGND	DGND	DIO1	DGND	DGND	DIO20
3	-	-	DIO2	-	-	DIO21
4	DGND	DGND	DIO3	DGND	DGND	DIO22
5	-	-	DIO4	-	-	DIO23
6	DGND	DGND	DIO5	DGND	DGND	DIO24
7	-	-	DIO6	-	-	DIO25
8	DGND	DGND	DIO7	DGND	DGND	DIO26
9	DIO38	DIO39	DIO8	DIO40	DIO41	DIO27
10	DGND	DGND	DIO9/	DGND	DGND	DIO28
11	-	-	DIO10	-	-	DIO29
12	DGND	DGND	DIO11	DGND	DGND	DIO30
13	-	-	DIO12	-	-	DIO31
14	DGND	DGND	DIO13	DGND	DGND	DIO32
15	-	-	DIO14	-	-	DIO33
16	DGND	DGND	DIO15	DGND	DGND	DIO34
17	-	-	DIO16	-	-	DIO35
18	DGND	DGND	DIO17	DGND	DGND	DIO36
19	DIO42/	DIO43/	DIO18	DIO_CLK+	DIO_CLK-	DIO37

Note: DIO pins connect to JP1, rear panel MDR68. All unused pins are not labeled.

Table 12. P16 Signal Descriptions

Signal	Description	P16 Pin
DIO0	Digital IO 0	C1
DIO1	Digital IO 1	C2
DIO2	Digital IO 2	C3
DIO3	Digital IO 3	C4
DIO4	Digital IO 4	C5
DIO5	Digital IO 5	C6
DIO6	Digital IO 6	C7
DIO7	Digital IO 7	C8
DIO8	Digital IO 8	C9
DIO9	Digital IO 9	C10
DIO10	Digital IO 10	C11
DIO11	Digital IO 11	C2
DIO12	Digital IO 12	C13
DIO13	Digital IO 13	C14
DIO14	Digital IO 14	C15
DIO15	Digital IO 15	C16
DIO16	Digital IO 16	C17
DIO17	Digital IO 17	C18
DIO18	Digital IO 18	C19
DIO19	Digital IO 19	F1
DIO20	Digital IO 20	F2
DIO21	Digital IO 21	F3
DIO22	Digital IO 22	F4
DIO23	Digital IO 23	F5
DIO24	Digital IO 24	F6
DIO25	Digital IO 25	F7
DIO26	Digital IO 26	F8
DIO27	Digital IO 27	F9
DIO28	Digital IO 28	F10

Signal	Description	P16 Pin
DIO29	Digital IO 29	F11
DIO30	Digital IO 30	F12
DIO31	Digital IO 31	F13
DIO32	Digital IO 32	F14
DIO33	Digital IO 33	F15
DIO34	Digital IO 34	F16
DIO35	Digital IO 35	F17
DIO36	Digital IO 36	F18
DIO37	Digital IO 37	F19
DIO38	Digital IO 38	A9
DIO39	Digital IO 39	B9
DIO40	Digital IO 40	D9
DIO4	Digital IO 41	E9
DIO42	Digital IO 42	A19
DIO43	Digital IO 43	B19
DIO_CLK+	Digital IO Clk+	D19
DIO_CLK-	Digital IO Clk-	E19

P1 – Cabled PCI Express Connector

Connector Types:	Miniature D-Sub, Male
Number of Connections:	18 total, arranged as two rows of 9 each
Connector Part Number	Molex 74150-001
Mating Cable:	See table of approved cables.

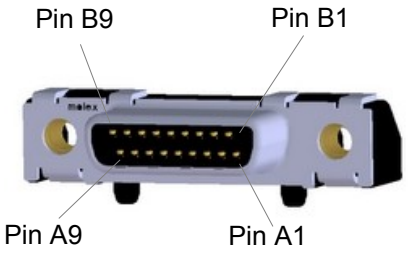


Table 13. P1 -PCI Express Connector Pinout

Pins	Signal
A1/A2	PEX_RXn/p
A5/A6	PEX REFCLKn/p
B8/B9	PEX Txn/p
A9, B1, B5	GROUND
A8	PEX RESETn
B3	WAKEn
B4	PRESENTn
B7	PWR ON
A4	SB_RTN
A3, A7, B2, B6	No Connects

Power Connector

The power connector can connect to many AC -DC supplies or a cable may be made with the mating connector specified. The outer diameter is 5.5 mm, the inner barrel is 2.1mm.

Connector Types:	2.1 MM Barrel Connector
Number of Connections:	2
Connector Part Number	CUI P/N PJ-005A
Mating Connector:	CUI P/N PP3-002A

Inner barrel is Vin (+12V nominal). Outer shell is ground. Input Voltage Range is 9-16 VDC.

Mechanicals

The following diagram shows the eInstrument Node carrier card connectors and dimensions.

Detailed drawings for mechanical design work are available through technical support.

Carrier Card Layout

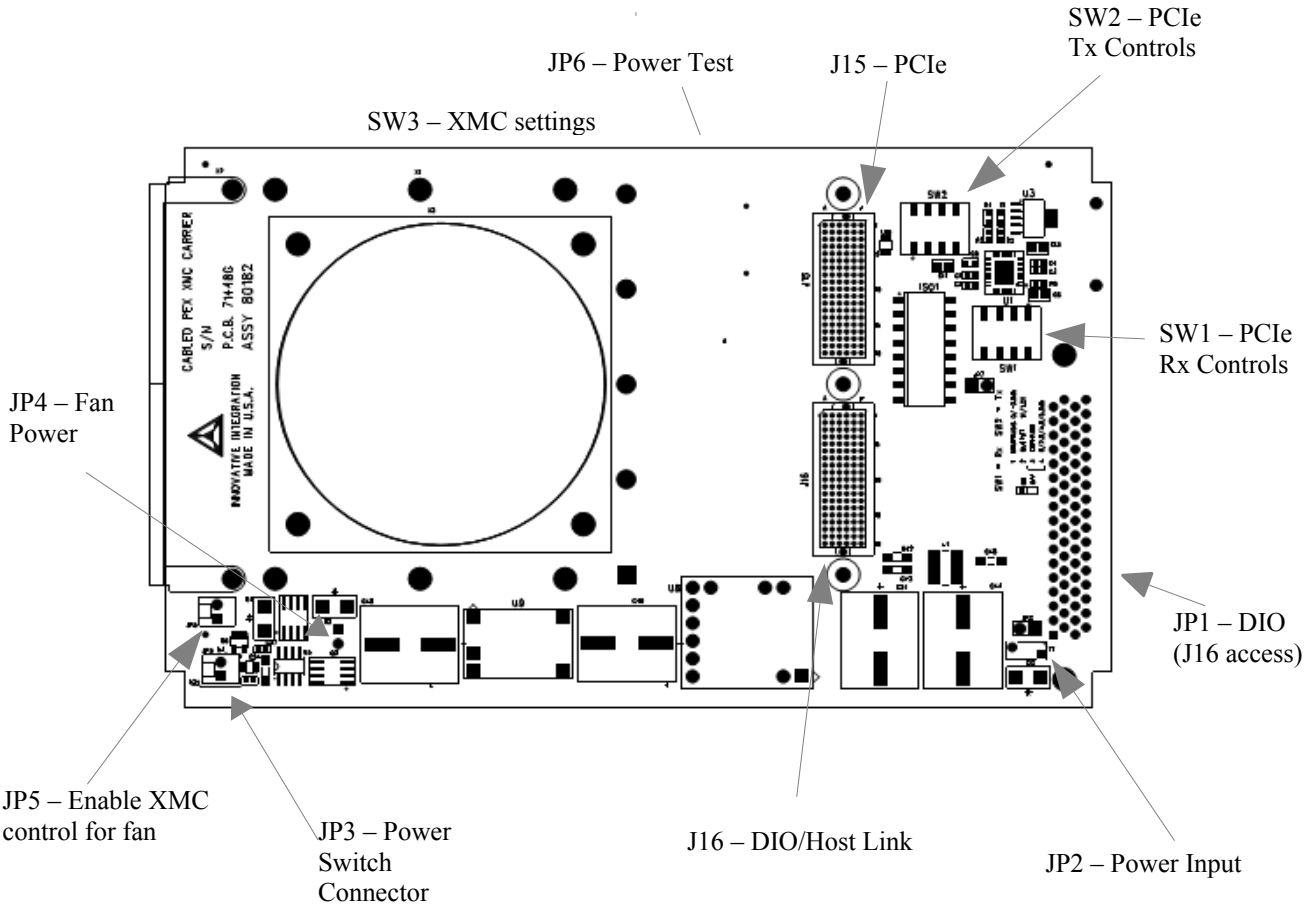


Figure 10. Connector locations on carrier card (Rev B and C)

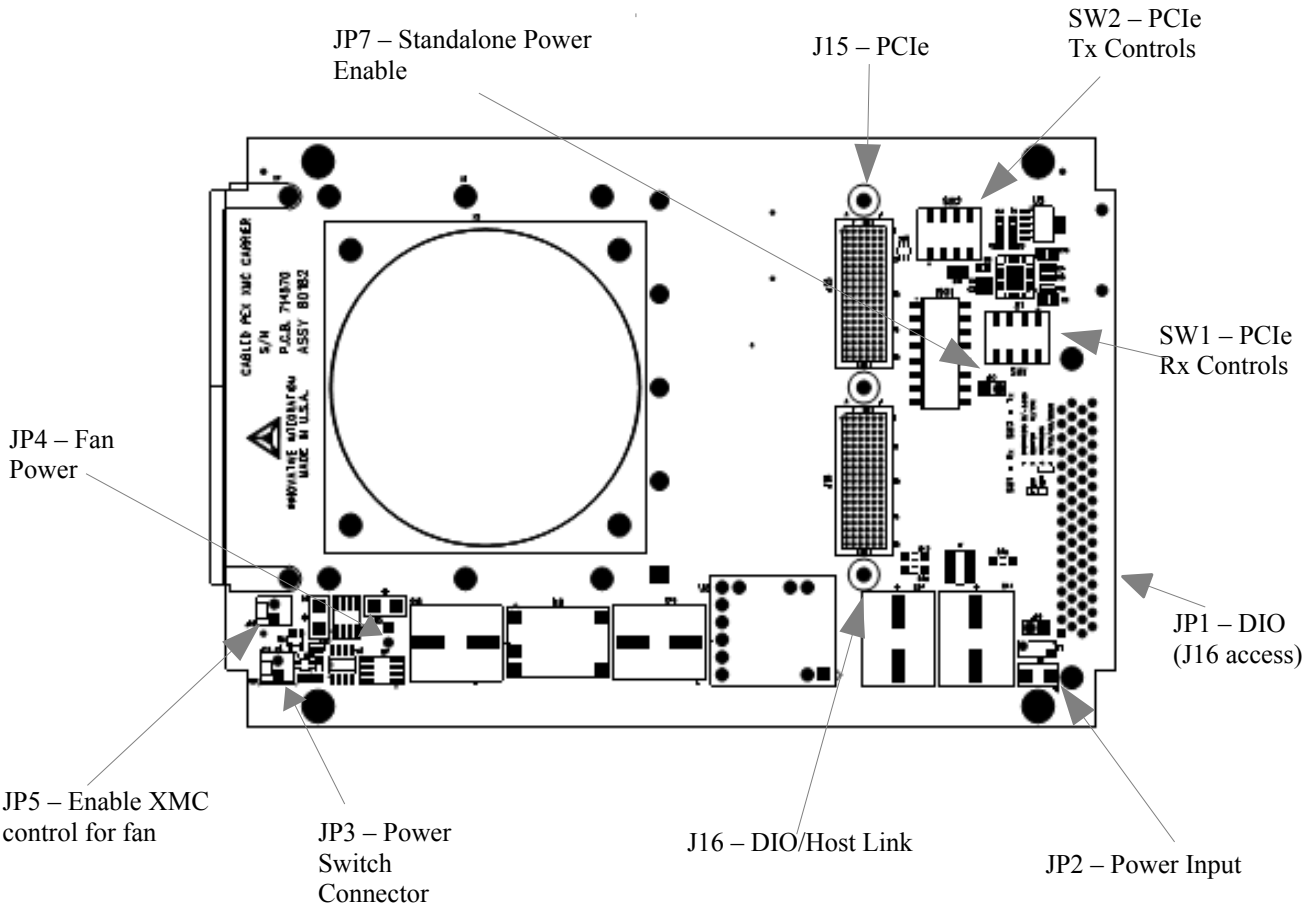
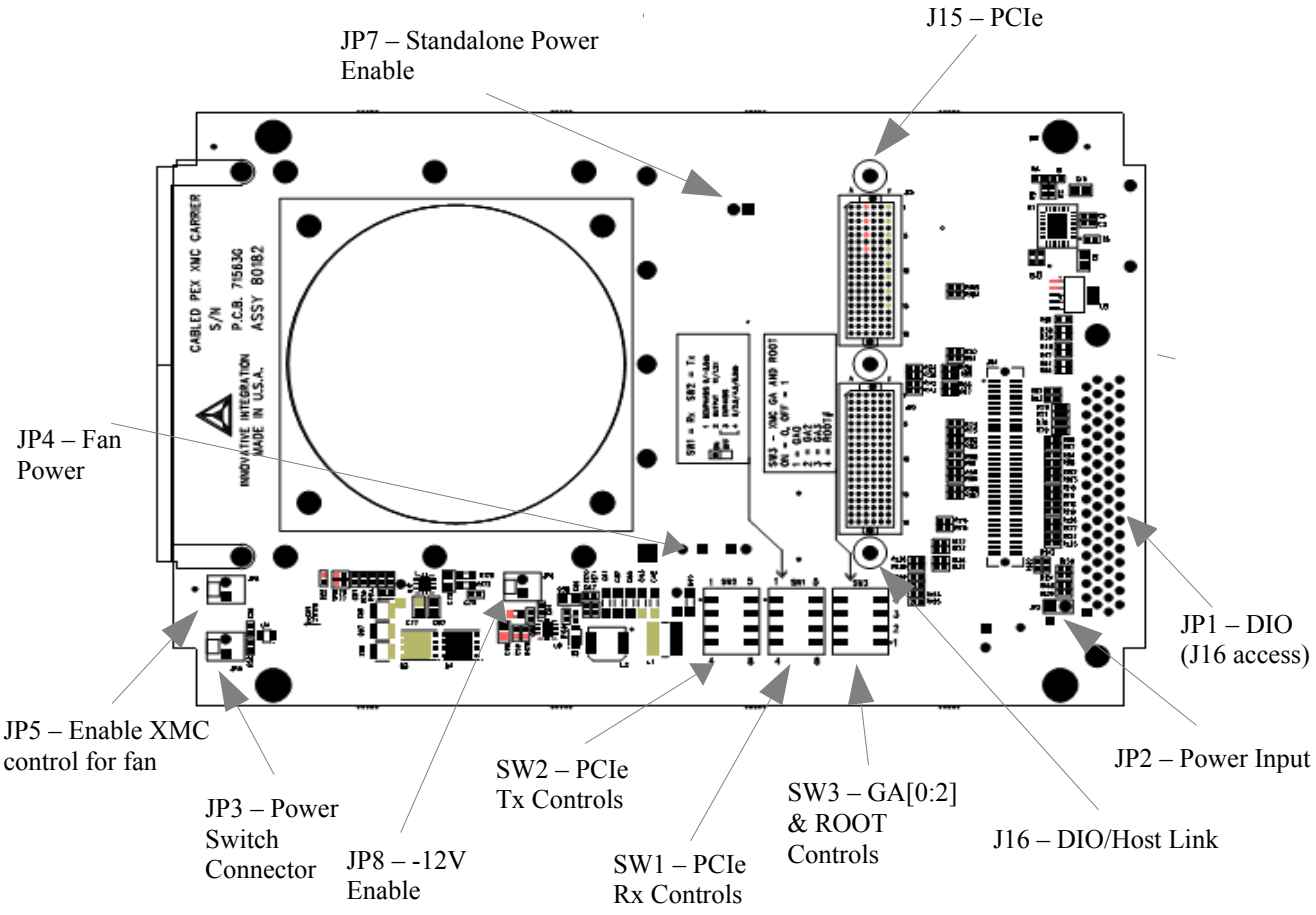

JP7 – Standalone Power Enable
J15 – PCIe
SW2 – PCIe Tx Controls
SW1 – PCIe Rx Controls
JP4 – Fan Power
JP1 – DIO (J16 access)
JP5 – Enable XMC control for fan
JP3 – Power Switch Connector
J16 – DIO/Host Link
JP2 – Power Input

Figure 11. Connector locations on carrier card (Rev D)

Figure 12. Connector locations on carrier card (Rev E)


J15 – PCIe
JP7 – Standalone Power Enable
JP4 – Fan Power
JP1 – DIO (J16 access)
JP5 – Enable XMC control for fan
JP2 – Power Input
SW2 – PCIe Tx Controls
JP3 – Power Switch Connector
SW3 – GA[0:2] & ROOT Controls
J16 – DIO/Host Link
JP8 – -12V Enable
SW1 – PCIe Rx Controls

Carrier Card Dimensions

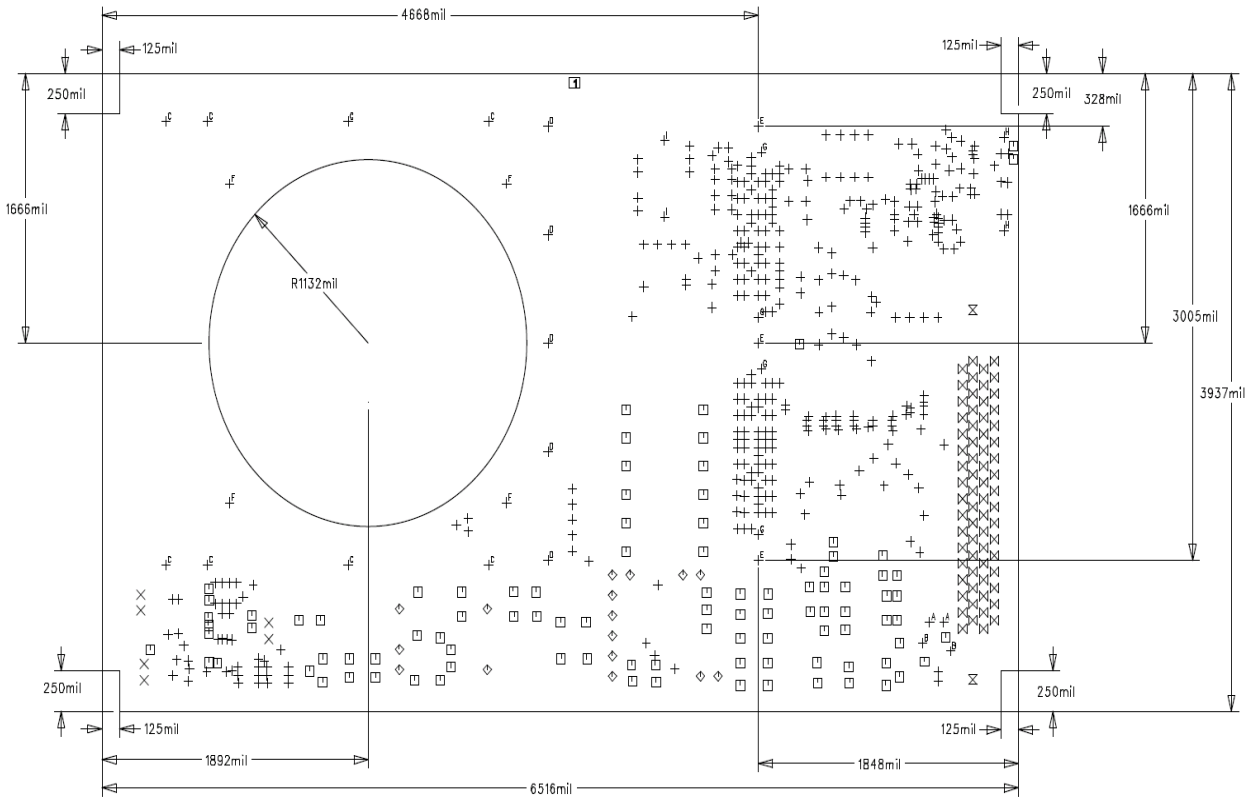


Figure 13. eInstrument Node Mechanicals Rev B

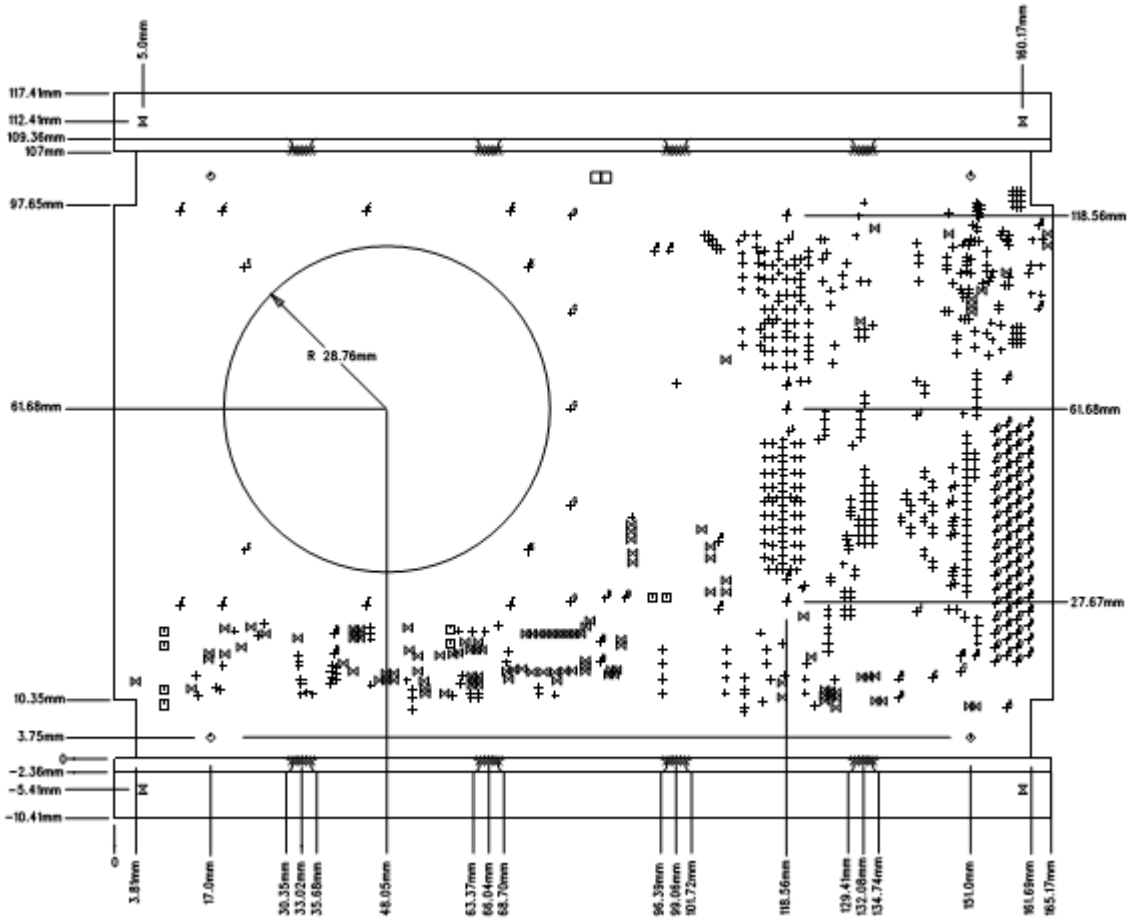
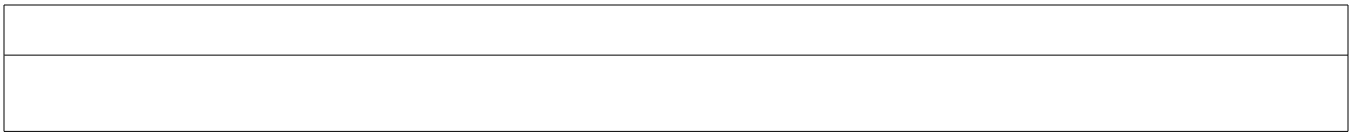


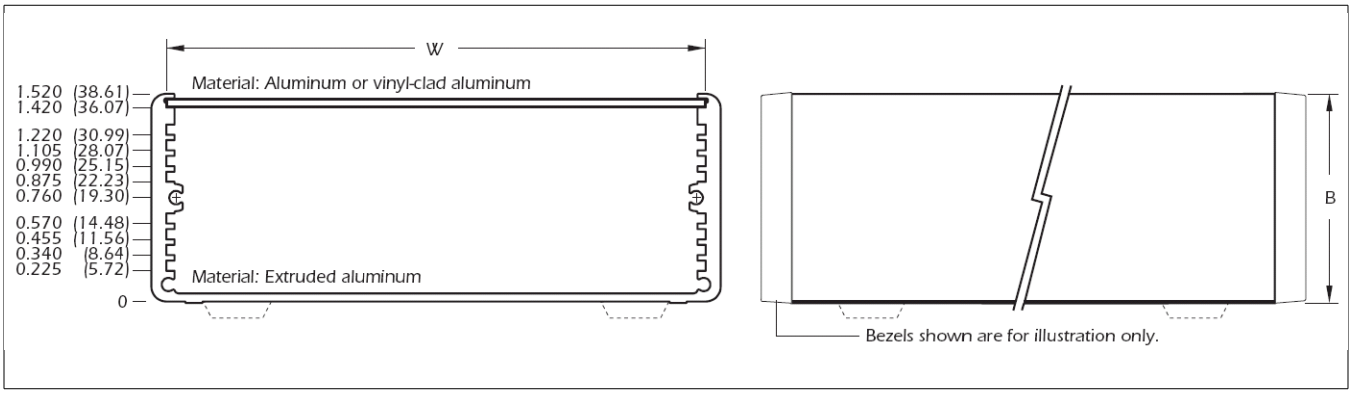
Figure 14. eInstrument Node Mechanicals Rev E



Enclosure Dimensions

Dimension	In (mm)
W (Width)	3.94 (100.1)
B (Height)	1.52 (38.6)
L (Overall Length)	6.75 (171.5)

Table 14. nclosure Dimensions (Rev A to C)



Dimension	In (mm)
W (Width)	3.94 (100.1)
B (Height)	1.52 (38.6)
L (Overall Length)	6.75 (171.5)

Table 15. Enclosure Dimensions

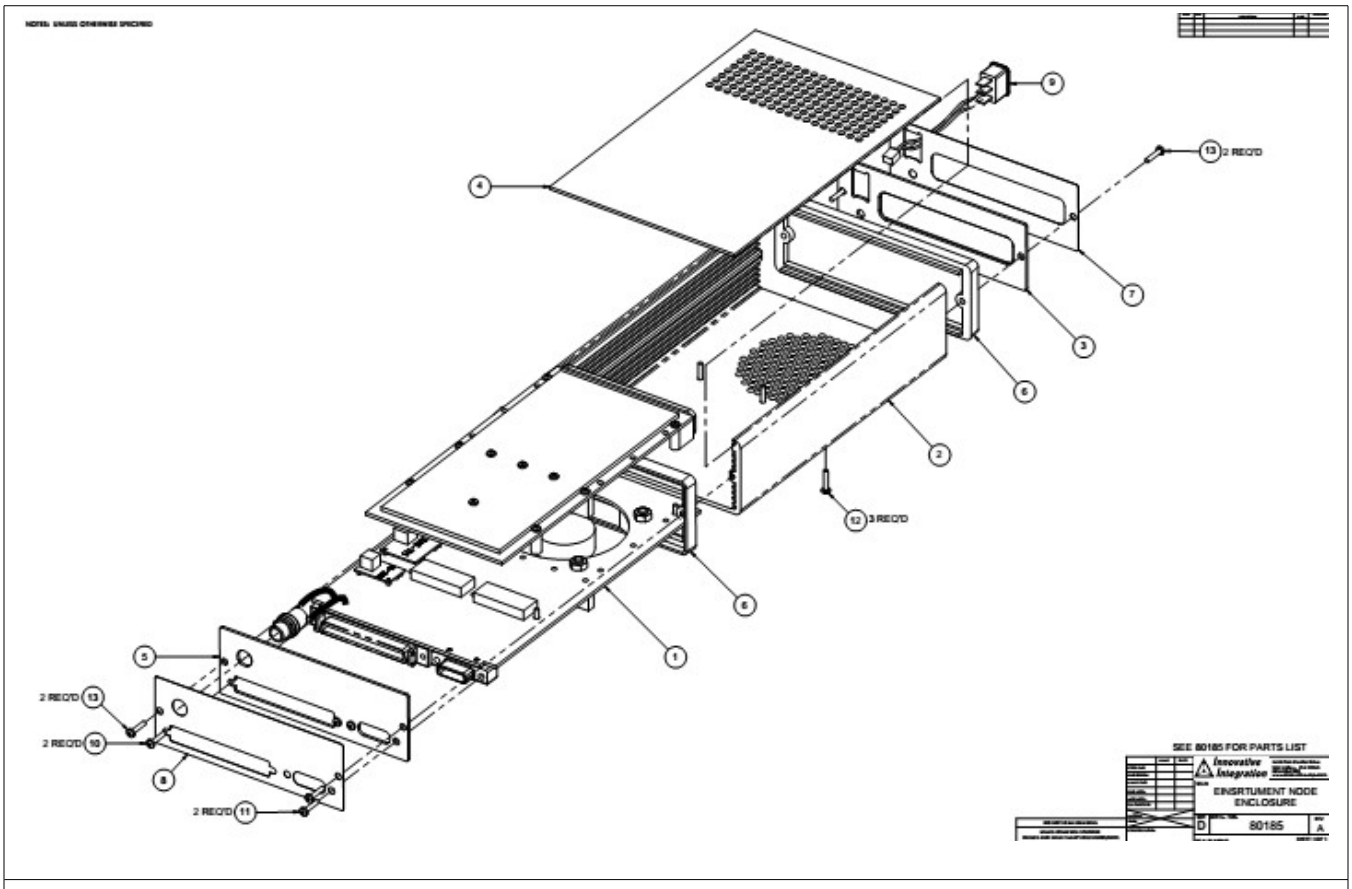


Figure 15. eInstrument Enclosure Chassis Assembly Rev A

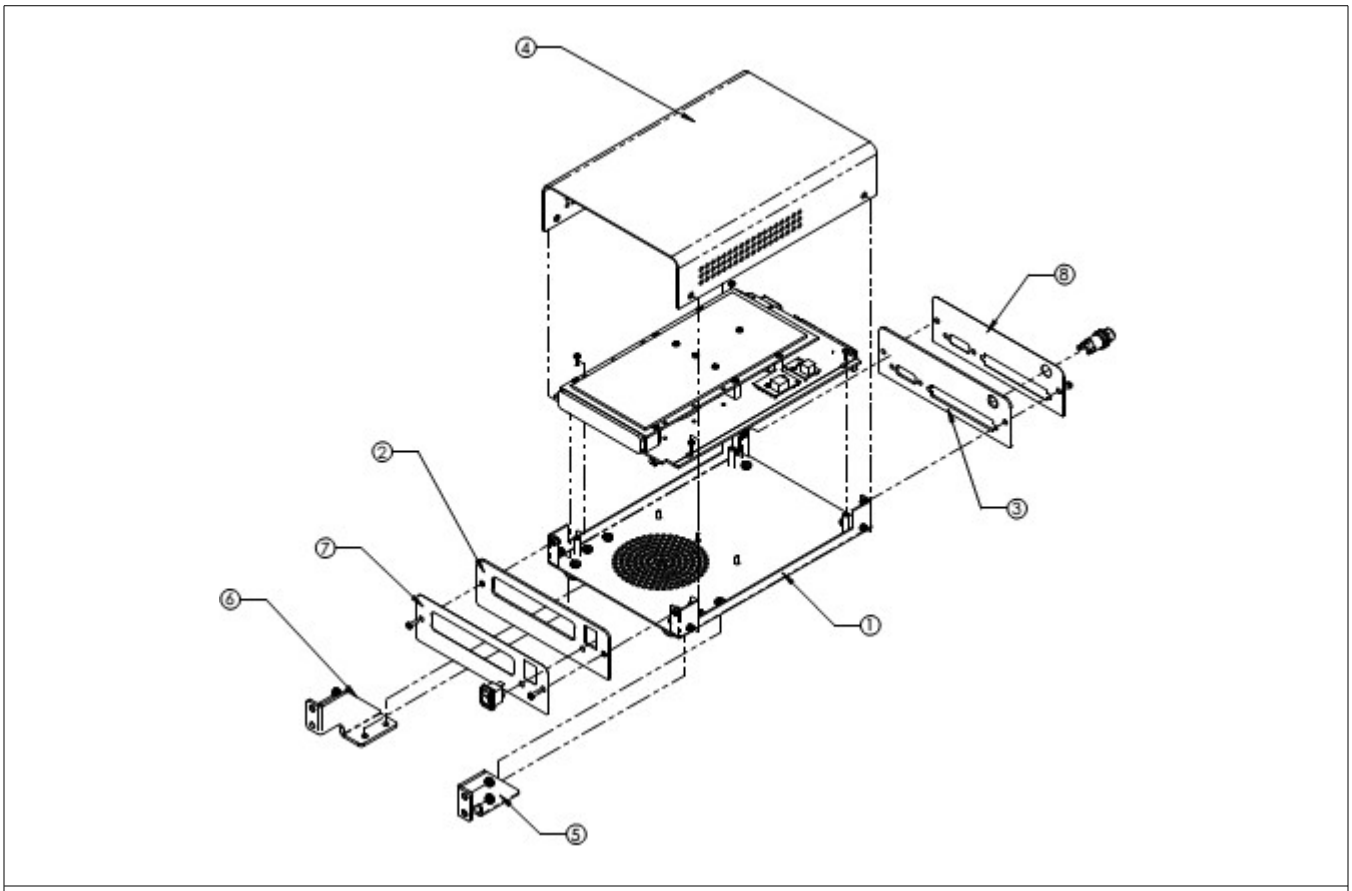


Figure 16. eInstrument Enclosure Chassis Assembly Rev B

Rackmount Dimensions

A 1U panel for a 19 inch rackmount is available. The panel mounts up to 4 eInstrument Nodes.

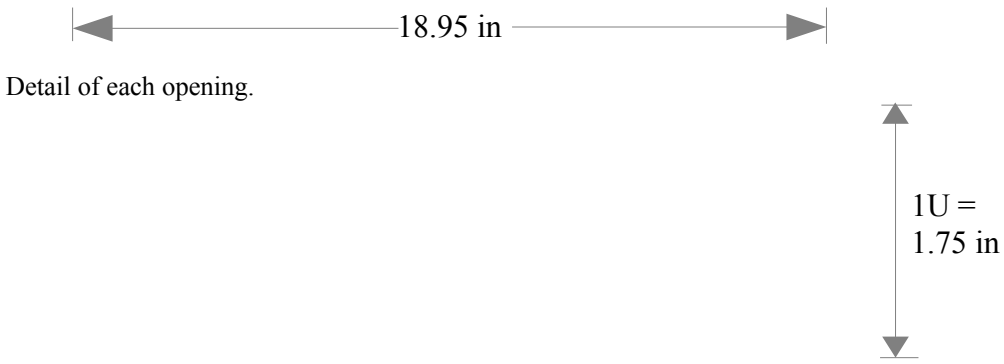


Figure 17. Rackmount Panel Dimensions